

# BIOTECHNOLOGY AND BIOCHEMICAL ENGINEERING MINOR

This minor provides specific training for McCormick students interested in industries that create and manufacture bio-based fuels and industrial chemicals, pharmaceuticals, biomaterials, and agents for gene and cell therapies or for those desiring in-depth preparation for future graduate study in biotechnology research.

Course	Title
<b>Requirements (10 units)</b>	
6 courses in biological science and biochemical engineering:	
BIOL_SCI 201-0	Molecular Biology <sup>1,2</sup>
BIOL_SCI 202-0	Cell Biology <sup>1,2</sup>
BIOL_SCI 203-0	Genetics and Evolution <sup>2</sup>
BIOL_SCI 301-0	Principles of Biochemistry
CHEM_ENG 375-0	Biochemical Engineering
CHEM_ENG 377-0	Bioseparations

Laboratory experience:

The complete series of 0.34-unit laboratories or one unit of 399 independent study in an approved laboratory <sup>3</sup>	
BIOL_SCI 232-0	Molecular and Cellular Processes Laboratory
BIOL_SCI 233-0	and Genetics and Molecular Processes Laboratory
BIOL_SCI 234-0	and Investigative Laboratory

3 electives providing opportunity for greater depth in both fundamental biology and engineering applications:

1 course from Core Electives (p. 1)
2 courses from Extended Electives (p. 1)

<sup>1</sup> CHEM\_ENG 275-0 Molecular & Cell Biology for Engineers may substitute for either one

<sup>2</sup> The Biotech Minor requires 3 units of Biology coursework. Exemptions or course reductions are NOT granted for students taking the Biological Sciences Department placement test, and who test out of and skip BIOL\_SCI 201-0 Molecular Biology. These students may complete BIOL\_SCI 202-0 Cell Biology and BIOL\_SCI 203-0 Genetics and Evolution and petition to use an upper level Biology course to complete the required 3 units of Biology coursework. ISP students may use the full 3 course sequence BIOL\_SCI 239-0 Fundamentals of Biological Mechanisms, BIOL\_SCI 240-0 Fundamentals of Cellular Processes, and BIOL\_SCI 241-0 Fundamentals of Multicellular Complexity.

<sup>3</sup> Biological Science laboratories are now connected to the intro sequence courses, and registration in the lab is required. Students who are transferring credit from a previous institution where there is no coupled lab, or who do not have one full unit of laboratory credit, may use a previously approved independent study. Any student may choose to substitute a previously approved independent study unit in place of the three laboratory courses.

- A minimum GPA of 2.0 is required in courses in the minor.
- A BA or BS degree from Northwestern must be completed.
- At least 4 units of coursework must be unique to this minor program. These units cannot be applied to any other minor or certificate program, or the major requirements of any degree program. Such coursework may fulfill McCormick Social Sciences/Humanities

(Theme), WCAS distribution requirements, or other unrestricted electives.

- A maximum of 2 units not offered by the department may be taken P/N for the minor. Students must also comply with departmental and McCormick P/N regulations for courses that are double-counted toward requirements in the minor and major programs.
- Students not majoring in chemical engineering should take the Biological Sciences intro sequence BIOL\_SCI 201-0 Molecular Biology, BIOL\_SCI 202-0 Cell Biology, BIOL\_SCI 203-0 Genetics and Evolution, and BIOL\_SCI 301-0 Principles of Biochemistry before CHEM\_ENG 375-0 Biochemical Engineering and CHEM\_ENG 377-0 Bioseparations. They should also take CHEM 342-1 Thermodynamics and the recommended BIOL\_SCI 315-0 Advanced Cell Biology to prepare for CHEM\_ENG 375-0 Biochemical Engineering and CHEM\_ENG 377-0 Bioseparations.
- Students must submit an up to date minor declaration form in MAS (McCormick Advising System) (<https://mas.mccormick.northwestern.edu/>) before the beginning of their final quarter as undergraduates. Petitions for counting the independent study units are also completed in MAS.

## Minor Electives

### Core Electives

Course	Title
CHEM_ENG 372-0	Bionanotechnology
CHEM_ENG 373-0	Biotechnology and Global Health
CHEM_ENG 376-0	Principles of Synthetic Biology
CHEM_ENG 378-0	Deconstructing Synthetic Biology – Biotechnology Case Studies Across Scales
CHEM_ENG 379-0	Computational Biology: Analysis and Design of Living Systems
CHEM_ENG 382-0	Regulatory Sciences in Biotechnology
CHEM_ENG 470-0	Molecular Folding and Function
CHEM_ENG 478-0	Advances in Biotechnology
CHEM_ENG 395-0	Special Topics in Chemical Engineering (must be approved by petition)

### Extended Electives

Course	Title
CHEM_ENG 372-0	Bionanotechnology
CHEM_ENG 373-0	Biotechnology and Global Health
CHEM_ENG 376-0	Principles of Synthetic Biology
CHEM_ENG 378-0	Deconstructing Synthetic Biology – Biotechnology Case Studies Across Scales
CHEM_ENG 379-0	Computational Biology: Analysis and Design of Living Systems
CHEM_ENG 382-0	Regulatory Sciences in Biotechnology
CHEM_ENG 470-0	Molecular Folding and Function
CHEM_ENG 478-0	Advances in Biotechnology
CHEM_ENG 395-0	Special Topics in Chemical Engineering (must be approved by petition)
BIOL_SCI 315-0	Advanced Cell Biology
BIOL_SCI 323-0	Bioinformatics: Sequence and Structure Analysis
BIOL_SCI 328-0	Microbiology
BIOL_SCI 332-0	Conservation Genetics
BIOL_SCI 341-0	Population Genetics
BIOL_SCI 355-0	Immunobiology
BIOL_SCI 361-0	Protein Structure and Function

BIOL_SCI 363-0	Biophysics
BIOL_SCI 378-0	Functional Genomics
BIOL_SCI 380-0	Biology of Cancer
BIOL_SCI 390-0	Molecular Biology of Genome Editing and Engineering
BIOL_SCI 395-0	Molecular Genetics
BMD_ENG 304-0	Quantitative Systems Physiology (Formerly BMD_ENG 302)
BMD_ENG 317-0	Biochemical Sensors
BMD_ENG 340-0	Pharmaceutical Engineering: From Discovery to Therapeutics
BMD_ENG 343-0	Biomaterials and Medical Devices
BMD_ENG 344-0	Biological Performance of Materials
BMD_ENG 346-0	Tissue Engineering
BMD_ENG 347-0	Foundations of Regenerative Engineering
BMD_ENG 348-0	Applications of Regenerative Engineering
BMD_ENG 443-0	Biological Phenomena in Cell/Cell-Free Systems
BMD_ENG 446-0	Biomaterials in Synthetic Biology
CHEM 215-3	Organic Chemistry III (Formerly CHEM 210-3)
CIV_ENV 361-1	Environmental Microbiology
CIV_ENV 442-0	Environmental Biotechnology for Resource Recovery
MAT_SCI 353-0	Bioelectronics
Independent Study 399 in approved laboratory	